

**School of Kinesiology  
Faculty of Health Sciences  
Western University**

**EXERCISE BIOCHEMISTRY  
Kin 3360B  
Winter, 2017**

|                    |                     |                      |  |
|--------------------|---------------------|----------------------|--|
| <b>Instructor:</b> | J.M. Kowalchuk      | <b>Office:</b>       | HSB 411C   |
| <b>Location:</b>   | SEB-2099            | <b>Office Hours:</b> | by appointment (after first meeting with GTA)        |
| <b>Lectures:</b>   | M, W, F; 12:30-1:30 | <b>Email:</b>        | <a href="mailto:jkowalch@uwo.ca">jkowalch@uwo.ca</a> |
| <b>GTA:</b>        | TBA                 | <b>Email:</b>        | TBA  |

**NOTE:** All course information including grades, assignment outlines, deadlines, etc. are available via OWL.

**Calendar Description:** A study of human exercise biochemistry and metabolism with attention given to the major metabolic pathways and their control as they relate to acute and chronic responses and adaptations to exercise.

**Course Description:** This course will describe the major metabolic pathways associated with the transport and storage of substrate, and production of “energy equivalents” at rest and during different durations and intensities of exercise, as well as in other physiological or clinical conditions. In addition to describing individual steps in the pathways for carbohydrate and fat breakdown, utilization and synthesis, this course will examine regulation of these pathways in different tissues and in these various conditions, and how fuel use is integrated amongst tissues.

**Anti-requisite(s)/Pre-requisite(s)/Co-requisite(s) if applicable:**

Pre-requisites for this course are:

Physiology 1021 or equivalent; Kin 2230a/b or equivalent.

A previous introductory background in biochemistry / metabolism is recommended but not required.

You are responsible for ensuring that you have successfully completed all course pre-requisites, and that you have not taken an anti-requisite course (if applicable). Lack of a pre-requisite or the completion of an anti-requisite cannot be used as a basis for appeal. If you are found ineligible for a course, you may be removed from it at any time and you will receive no adjustment to your fees. This decision cannot be appealed.

**Course Format:**

Lectures held on Monday, Wednesday and Friday from 12:30 p.m. – 1:30 p.m.

**Course Recommended Textbook(s):**

Required Textbook:

PM Tiidus, AR Tupling, ME Houston. Biochemistry Primer for Exercise Science (4th ed). Human Kinetics, 2012.

Because there is no single textbook that covers all material adequately, lecture material will be taken from many sources, including many other University-level textbooks in biochemistry (e.g., DL Nelson and MM Cox, Lehninger: Principles of Biochemistry, W.H. Freeman & Co.; or D Voet, JG Voet and CW Pratt, Fundamentals of Biochemistry - Life at the Molecular Level, John Wiley & Sons, Inc.), and published, peer-reviewed research and review articles.

**Learning Objectives:**

Upon completion of this course students will be able to:

1. describe and explain the role of enzymes in metabolic pathways, and the different mechanisms by which they are regulated
2. describe and explain the bioenergetic requirements of muscle
3. describe individual steps in each of the metabolic pathways studied, and identify key steps where pathway regulation occurs and how “regulation” is achieved
4. describe and explain the metabolic responses to exercise of different intensity and duration
5. understand metabolic interactions amongst muscle and other tissue and organ systems
6. use examples from the published literature to help in the understanding of metabolic responses to exercise
7. understand the relationship between metabolism and certain disease states
8. describe and explain the relationship between metabolism and exercise performance

Note that these learning objectives may modified depending on the time constraints and on the material covered during the term.

**Required Course Material:**

References for all required course readings will be posted on OWL.

**Course Evaluation Summary:**

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|--|-----|
| Midterm (TBD)  | 50% |
| Final Exam (scheduled by the Registrar’s office during the April examination period) | 50% |

Exams will be a combination of multiple choice and short answer questions. Midterm examinations normally will be held outside of the assigned lecture time and at a time agreed upon by the instructor and a majority of students (usually between 5:00 p.m. and 7:00 p.m.). The instructor will try to ensure that midterm exams do not conflict with students’ schedules, but it may be necessary for the student to readjust/modify their personal schedule to accommodate the midterm. A missed midterm or final examination without appropriate documentation will result in a “zero” grade (note: attending athletic team practice is not an acceptable excuse to miss a scheduled examination). A “make-up” exam is not guaranteed. If a valid reason is provided, an alternate time may be considered but at the discretion of the course instructor. If a reasonable,

alternate, time cannot established, the final grade will be re-weighted at the discretion of the instructor in a manner that is fair to both the student and the other students in the class.

### **Course/University Policies**

1. **Written documentation:** Students requiring academic accommodation should provide notification and documentation in advance of due dates, examinations, etc. stating specific reasons and dates. Students must follow-up with their professors and their Academic Counselling office within 24 hrs of a missed midterm or final exam or course deadline. Documentation for any request for accommodation shall be submitted directly, as soon as possible, to the appropriate *Academic Counselling Office* of the student's Faculty/School of registration not to the instructor, with a request for relief specifying the nature of the accommodation being requested. This documentation should be obtained at the time of the initial consultation with the physician or walk-in clinic. These documents will be retained in the student's file, and will be held in confidence in accordance with the University's Official Student Record Information Privacy Policy.

See <https://studentservices.uwo.ca/secure/index.cfm> for specific policy and forms relating to accommodation.

2. **Grades:** Midterm and final examinations will not be returned, but students are able to view their exams by making an appointment with the course GTA. Should you have a concern regarding the grade you received, this should be documented with the GTA. However, be aware that in requesting a grade reassessment, the entire exam could be re-evaluated and your grade could go up/down/or stay the same. Note that calculations errors (which do occur!) should be brought to the attention of the GTA immediately.

3. **Scholastic offences:** They are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

[http://www.uwo.ca/univsec/handbook/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf).

Computer marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

4. According to the Examination Conflict policy, "A student who is scheduled to write more than two examinations in any 24-hour period may request alternative arrangements through the office of their Academic Counsellor." *This policy does NOT apply to mid-term examinations.*

5. **Classroom Behaviour:** Class will begin promptly at the time specified in this syllabus. In the event that you must arrive late, please enter the classroom with a minimal disturbance to the class. The course instructor or GTAs reserve the right to lock the classroom door and deny entrance if lateness becomes a common occurrence. Excessive talking during class time is disruptive, disrespectful, and will not be tolerated. Students engaging in such behaviour may be asked to leave the room. Cellular phones, pagers, and text-messaging devices are disruptive when they ring in class. If you must bring these with you, please place them on silent mode or turn them off during class. Failure to do so may result in your being asked to leave.

6. Laptops for the **purpose of viewing lecture material and typing lecture notes** are permitted in class, but please be respectful to your fellow students and turn the sound off. If complaints are received from other students regarding noise or other disruptive behaviour (e.g., watching videos on YouTube.com, updating your Facebook status, playing Solitaire), your classroom laptop privileges will be revoked. Audio and/or videotaping of lectures is not permitted unless approval has been sought from the instructor in advance.

### **STUDENT CODE OF CONDUCT**

The purpose of the Code of Student Conduct is to define the general standard of conduct expected of students registered at Western University, provide examples of behaviour that constitutes a breach of this standard of conduct, provide examples of sanctions that may be imposed, and set out the disciplinary procedures that the University will follow. For more information, visit the website <http://www.uwo.ca/univsec/board/code.pdf>

### **ENGLISH PROFICIENCY FOR THE ASSIGNMENT OF GRADES**

Visit the website <http://www.uwo.ca/univsec/handbook/exam/english.pdf>

### **SUPPORT SERVICES**

There are various support services around campus and these include, but are not limited to:

1. Student Development Centre -- <http://www.sdc.uwo.ca/ssd/>
2. Student Health -- <http://www.shs.uwo.ca/student/studenthealthservices.html>
3. Registrar's Office -- <http://www.registrar.uwo.ca/>
4. Ombuds Office -- <http://www.uwo.ca/ombuds/>

## **Tentative Course Outline &/or Proposed Topics To Be Covered:**

1. Amino acid, peptides and proteins
  - The nature of amino acids
  - Characteristics of peptides
  - Structure of proteins
  
2. Enzymes
  - Enzymes as catalysts
  - Rates of enzymatic reactions
  - Enzyme inhibition
  - Regulation of enzyme activity
  - Provision of reactive groups by cofactors
  - Oxidations and reductions
  
3. Bioenergetics
  - Free Energy
  - Energy-rich phosphates
  - Energy systems
  
4. Carbohydrate metabolism
  - Carbohydrates
  - Cellular uptake of glucose
  - Phosphorylation of glucose
  - Glycolysis
  - Glycogen metabolism (glycogen synthesis; glycogenolysis)
  - Regulation of glycogen/glucose metabolism (in muscle and liver)
  - Pyruvate/Lactate metabolism and transport
  - Oxidation of cytoplasmic NADH and shuttle systems
  - Gluconeogenesis
    - Regulation of gluconeogenesis
    - Pentose Phosphate Pathway
  
5. Oxidative phosphorylation
  - Overview
  - Mitochondria
  - Mechanism of oxidative phosphorylation
  - Role of the tricarboxylic acid cycle
  - Reactions of the tricarboxylic acid cycle
  - Electron transfers
  - Coupled phosphorylation
  - Mitochondrial transport of ATP, ADP and Pi
  - Regulation of oxidative phosphorylation
  
6. Lipid metabolism
  - Types of lipids

- Lipogenesis and lipogenolysis and their regulation
  - Oxidation of fatty acids
  - Oxidation of ketone bodies
  - Fatty acid synthesis and regulation
7. Metabolism in exercise: fat vs carbohydrate
  8. Amino acid metabolism
    - Overview
    - Degradation of amino acids
    - Urea cycle
    - Fate of amino acid carbon skeletons
    - Amino acid metabolism in exercise
  9. Gene transcription and its control
    - Types of RNA
    - The genetic code
    - Transcription and its regulation
  10. Protein synthesis and degradation
    - Post-transcriptional modifications of RNA
    - Translation and its regulation
    - Post-translational processing of polypeptides
    - Protein degradation

**Note: Course Content:**

Some “basic” course material may be covered only as assigned readings. While it is hoped that many of the topics listed above will be covered to varying degrees during the term, it is likely that time constraints will not permit examination of all topics, and that the order of presentation might change, or that other topics may be added.